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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

January 14, 2000

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th St., S.W.
Washington, DC 20554

EX PARTE OR LATE FILED

Re: ***Ex Parte* Notification**
ET Docket No. 98-153
Ultra-Wideband

Dear Ms. Salas:

This is to note that on January 13, 2000, Mimi Dawson of this firm and I met with Bryan Tramont, Legal Advisor to Commissioner Harold Furtchgott-Roth, and then with Mark Schneider, Senior Legal Advisor to Commissioner Susan Ness, to discuss the propects for a rulemaking on ultra-wideband technologies.

We urged the Commission to (1) move promptly in adoption of a notice of proposed rulemaking on UWB; (2) keep open its options in any such notice insofar as constraints on the technical aspects of UWB operation are concerned; and (3) to look for ways to phase in UWB operations so that at least some portion of this rulemaking can be completed before the end of the year 2000.

We provided a copy of the enclosed article from *The Economist* of November 6, 1999, and are enclosing herewith a letter from the FAA to Time Domain, which has heretofore been provided to you and to the Office of Engineering and Technology.

Should any questions arise concerning this matter, please contact me.

Respectfully,

David E. Hilliard

David E. Hilliard
Counsel for Time Domain Corporation

cc: Messrs. Tramont and Schneider (w/ enclosures)

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The Economist

Bandwidth from thin air

Two new ways of transmitting data by wireless exploit unconventional approaches to create valuable additional capacity

They may be invisible, yet chunks of radio spectrum are fought over just as much as parcels of land. Governments raise billions by auctioning parts of the spectrum to mobile-phone companies and radio and television stations. Other frequencies are reserved for air-traffic control or the sending of distress signals. The most desirable addresses on the spectrum, like apartments in the trendiest parts of town, are in short supply—hence the high prices paid for them. To make the most of limited "bandwidth", as it is known, engineers have devised elaborate schemes to allow several devices (such as mobile telephones) to share a single frequency by taking turns to transmit.

Two emerging technologies now promise to propel such trickery into new realms, by throwing conventional ideas about radio transmission out of the window. The first involves multiple simultaneous transmissions on the same frequency. The second, by contrast, transmits on a huge range of frequencies at once. Outlandish though it sounds, the effect in both cases is to create hitherto unforeseen reserves of valuable bandwidth, practically out of thin air.

Don't all talk at once. Actually, do

Turn the dial (or press a button) on a radio, and you determine which station's signal is played through the speaker. Now imagine that several radio stations are transmitting on exactly the same frequency, so that their signals interfere with one another. Is it possible to build a new kind of radio, capable of separating the signals, so that just one of them can be heard clearly?

The conventional answer is no. Once radio signals have been mixed together, trying to separate them is like trying to unscramble an egg. In 1996, however, Gerard Foschini of Bell Labs (the research arm of Lucent Technologies, based in Murray Hill, New Jersey) suggested that multiple transmissions on a single frequency could be separated after all—by using more than one receiving antenna and clever signal processing. The result was a technology called Bell Labs Layered Space-Time, or BLAST.

The prototype system, which is now being tested, transmits via an array of 12 antennae, all of which broadcast a different signal, but on exactly the same frequency. At the receiving end are 16 antennae, also spaced out, each of which receives a slightly different mixture of the 12 broadcast signals—which have bounced and scattered off objects along the way.

Computer analysis of the differences between the signals from the receiving antennae, helped by the fact that those receiving antennae outnumber the transmitting ones, enables the 12 original signals to be pieced together.

Exploiting this result, it should become possible to transmit far more data than before over a wireless channel of a particular size. For convenience, the researchers used a channel "width" of 30kHz, the size of the channel used by analogue mobile phones. Normally, a data-hungry process such as accessing a web page over such a link is painfully slow. But using BLAST, transmission speeds of up to 1m bits per second have been achieved. By increasing the number of antennae at each end, it should become possible to squeeze even more capacity out of a fixed-size channel, albeit at the cost of far greater computational effort.

The technology is not, however, intended for mobile use. The multiple transmitting and receiving antennae, and the powerful signal-processing hardware involved, will be difficult to fit inside portable devices. In any case, too much moving around causes the mixture of signals received by each of the antennae to vary in ways that even the most sophisticated computer cannot cope with. Instead, according to Reinaldo Valenzuela, who is in charge of the research,

BLAST is more suitable for use in fixed wireless applications, such as providing high-speed Internet access to homes, schools and offices, or establishing telephone networks in isolated areas without laying cables.

If transmitting several signals on the same frequency sounds odd, what about transmitting on many frequencies simultaneously? That is the principle behind another novel form of wireless-communications technology known as ultra-wideband (UWB). This is being developed by a small company called Time Domain, which is based in Huntsville, Alabama. The technology is the brainchild of Larry Fullerton, an engineer who has spent the past 23 years working on the idea.

Whereas conventional transmitters (and BLAST transmitters) operate at a particular frequency, just as a single key on a piano produces a particular note, a UWB transmitter emits a pulse of radiation that consists of lots of frequencies at once, akin to the cacophony that ensues when all the keys on a piano are pressed at the same time. The pulse is very short—just half a nanosecond (billionth of a second)—and is transmitted at extremely low power. Because it is a mixture of so many frequencies, such a pulse passes unnoticed by conventional receivers, which are listening for one particular frequency

But to a UWB receiver, listening on a wide range of frequencies at once, it registers as a distinct pulse Information is sent by transmitting a stream of pulses—apparently at random (to fool conventional receivers), but actually at carefully chosen intervals of between 50 and 150 nanoseconds, in a pattern known to both transmitter and receiver By varying the exact timing of each pulse to within a tenth of a nanosecond, slightly early and slightly late pulses can be used to encode the zeroes and ones of digital information The resulting system can transmit data at 10m bits per second, without any interference with conventional transmissions

Or so Mr Fullerton and his backers at Time Domain contend So far, however, America's Federal Communications Commission (FCC) has not approved the technology for anything more than experimental use But there are signs that UWB could, after a long gestation, soon emerge into the marketplace At a conference in September to rally support for it, Susan Ness, an FCC commissioner, spoke in support of the technology and said regulations permitting it to be used would be announced next year

Several firms are lining up to make products based on UWB technology Time Domain, which owns the relevant patents, plans to supply these firms with its chip, called PulsON, to do the hard work of generating and detecting UWB pulses And as well as communications, UWB also has an intriguing potential use in radar (see article)

Neither BLAST nor UWB quite create something out of nothing Both technologies cunningly conjure up extra bandwidth at the cost of increased computational complexity Over the past few years, however, the cost of computing power has plummeted, and demand for bandwidth has soared Trading one for the other could prove to be a very good deal

How to look through walls

Besides its use in communications (see other article), ultra wideband (UWB) pulse radio might have a future as a radar that can see through walls, and do so in great detail It should, its manufacturers hope, be able to distinguish a cat from a cat burglar, or detect barely breathing bodies under several metres of rubble after an earthquake More mundanely, do-it-yourself enthusiasts will be able to use it to check for power cables and pipes beneath the plaster before they start drilling

UWB radar works like normal radar in so far as it depends on sending out radio signals and listening for the reflection But unlike ordinary radar, which takes the form of continuous waves, UWB signals are short pulses of energy

As a means of radio communication, UWB works because the chips in the receiver are able to time the pulses they are hearing to within a few thousand-billionths of a second Even at the speed of radio (ie, the speed of light), a pulse will travel only a few millimetres in that time Since, in the case of radar, the receiver is also the transmitter, it knows exactly when a pulse was sent By measuring how long that pulse takes to return, it can place the distance to the point of reflection to within that level of accuracy—enough to tell whether an aircraft's wing-flaps are up or down Four million pulses a second are sent out to provide a near-perfect picture of what the target looks like

Conventional radar relies on high-frequency (and therefore short wavelength) radio waves to achieve high resolution Long waves would produce fuzzy images But when the resolution depends on pulse-length, wavelength does not matter So UWB radar can employ significantly longer wavelengths, and these can penetrate a wide range of materials, such as brick and stone, which are denied to their shortwave cousins The result is "RadarVision", which, like the communication technology, is manufactured by Time Domain Though still experimental, it is being tested by several police forces around America They are using it to look inside closed rooms that might be harbouring suspects, before the guys with the sledgehammers batter the door down If it works, television cop-shows will never be the same again

U.S. Department
of Transportation

Federal Aviation
Administration

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Mr. Ralph Petroff
President and Chief Executive Officer
Time Domain Corporation
Cummings Research Park
6700 Odyssey Drive
Huntsville, AL 35806

Dear Mr. Petroff:

I would like to thank you for your letter dated October 12, 1999. This letter is my attempt to address the issues raised in that letter and those in our subsequent telephone conversation on October 22, 1999.

We fully support the Federal Communications Commission (FCC) plan to complete a rulemaking that addresses the ultra-wideband (UWB) technology regulatory issues, and the associated electromagnetic compatibility (EMC) testing before the end of the calendar year 2000. As you know, the issue with which we are most concerned is the potential for electromagnetic interference from UWB emissions to the operation of aeronautical radionavigation aids, which are certified by the Federal Aviation Administration (FAA) for use by aviation.

For example, the frequency band in which Global Positioning System (GPS) operates is jointly regulated by the FCC and the National Telecommunications and Information Administration (NTIA). NTIA will be working with the FCC in developing the UWB EMC test plan and rulemaking in the context of compatibility with the Global Navigation Satellite System, of which the GPS is an integral part. This important spectrum issue must be worked through the regulatory process, therefore, the FAA will work with NTIA and FCC to develop a national policy on UWB technologies. Towards this goal, the FAA will support NTIA's testing and rulemaking efforts.

I hope this clarifies the FAA position. We appreciate your continuing interest in aviation safety and hope that we share the goal of ensuring that UWB technology is implemented without degradation to the safety of our Nation's airways. Please feel free to contact me at (202) 267-9710 if you have any additional questions.

Sincerely,

G. J. Markey

Gerald J. Markey
Program Director for Spectrum
Policy and Management